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SPECIFICATION FOR EQUIPMENT FOR ENVIRONMENTAL TESTS FOR ELECTRONIC AND ELECTRICAL ITEMS

PART 7 BUMP TEST MACHINE

UDC 621·38·038 + 621·31 : 620·178·786·05

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SPECIFICATION FOR EQUIPMENT FOR ENVIRONMENTAL TESTS FOR ELECTRONIC AND ELECTRICAL ITEMS

PART 7 BUMP TEST MACHINE

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SPECIFICATION FOR EQUIPMENT FOR ENVIRONMENTAL TESTS FOR ELECTRONIC AND ELECTRICAL ITEMS

PART 7 BUMP TEST MACHINE

0. FOREWORD

0.1 This Indian Standard (Part 7) was adopted by the Indian Standards Institution on 8 March 1983, after the draft finalized by the Environmental Testing Procedures Sectional Committee had been approved by the Electronics and Telecommunication Division Council.

0.2 The object of this standard (Part 7) is primarily to guide the environmental equipment manufacturers with respect to broad specifications for their equipment and to assist the users of such equipment to properly define their requirements in the indent of the equipment. The requirements of the equipment largely depend on the conditions of environmental tests to be simulated or created. It is expected that this standard will harmonize the various requirements of the equipment.

0.3 Certain requirements have been specified in a general form in view of practical difficulties in defining such requirements quantitatively. It is presumed that with the experience gained, more precise requirements will be laid down for such equipment.

0.4 An overall performance assessment of the complete equipment for a short duration has been included although it may be realized that it may not be entirely sufficient. This will at least ensure the functional performance and operatability of the equipment. Many of the constructional requirements specified may be checked through visual examination.

0.5 In view of the subjective nature of some of the requirements, sufficient care shall be taken in using the standard.

0.6 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS : 2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

---

*Rules for rounding off numerical values (*revised*).

1. SCOPE

1.1 This standard (Part 7) lays down guiding requirements for the design of bump test machine required for carrying out bump tests in accordance with Sec 2 of IS : 9000 (Part 7)-1979*.

2. TERMINOLOGY

2.1 For the purpose of this standard, the definitions and explanation of terms given in IS : 9000 (Part 1)-1977† shall apply.

3. BUMP TEST MACHINE AND MEASURING SYSTEM

3.1 Characteristics of the Bump Test Machine — The bump test machine, as shown in Fig. 1, shall satisfy the characteristics specified below at the monitoring point. The characteristics shall be checked with the machine loaded for the conditioning process with the test item and any other necessary loading.

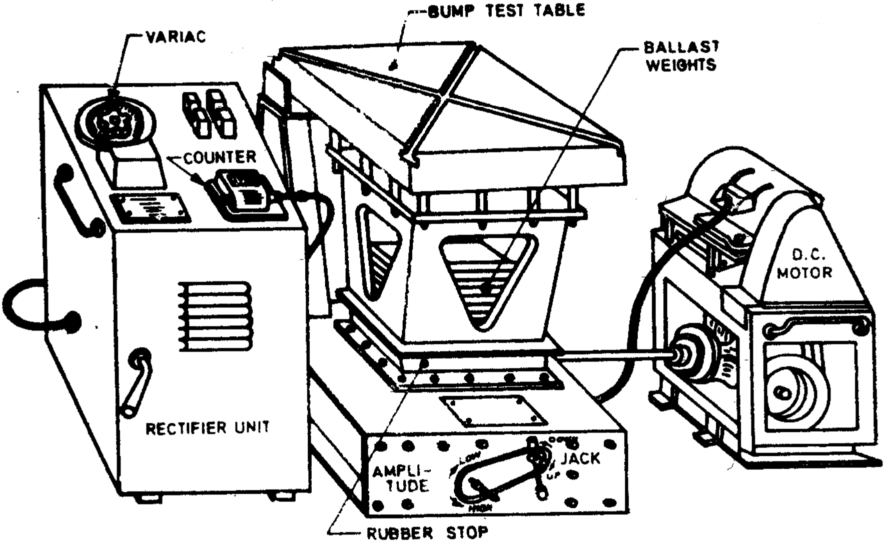

FIG. 1 BUMP TEST MACHINE

3.1.1 The table shall experience a free fall.

3.1.2 The bump repetition rate may be adjustable to 1 to 3 bumps per second so that the bump table reaches its lowest position of rest before being raised once more.

---

*Basic environmental testing procedures for electronic and electrical items: Part 7 Impact test.

†Basic environmental testing procedures for electronic and electrical items: Part 1 General.

3.1.3 The preferred mean peak acceleration shall be 400 m/s^2 ± 20 percent when the table is correctly loaded to its nominal value.

NOTE — With a drop height of 25 ± 4 mm, it may be possible to achieve this acceleration (*see also* **4.1.2**).

3.1.4 *Basic Pulse Shape* — The bump test machine shall be capable of generating a pulse approximating to one-half cycle of a sine wave and the duration of a half cycle of values given in **3.1.8.** The true values of acceleration and duration of the actual pulse shall be within the tolerance boundary shown in Fig. 2.

3.1.5 *Bump Repetition Rate* — The bump repetition rate shall be such that between impulses the relative motion within the item shall be substantially zero and the value of acceleration at the monitoring point shall be within the limits shown in Fig. 2. A rate of 1 to 3 per second is usually adequate.

3.1.6 *Velocity Change Tolerance* — The actual velocity change shall be within ± 20 percent of the value corresponding to the nominal pulse as given in **3.1.8.** Velocity change shall be determined by integrating the actual pulse from 0·4 D before the pulse to 0·1 D beyond the pulse, where D is the length of the nominal pulse (*see* Fig. 2).

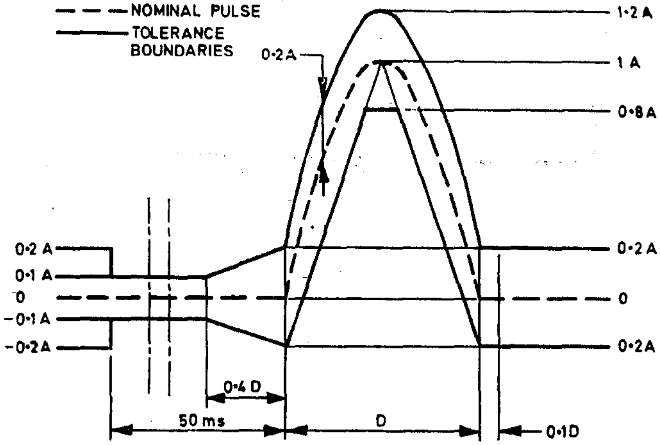

FIG. 2 PULSE SHAPE (HALF-SINE) FOR BUMP TEST

3.1.7 *Transverse Motion* — The positive or negative peak acceleration at the monitoring point, perpendicular to the intended bump direction, shall not at any time exceed 30 percent of the peak acceleration of the nominal pulse in the intended direction, when determined with a measuring system in accordance with **3.2**.

3.1.8 *Acceleration and Duration of the Pulse*

Peak Acceleration (*A*)	*Corresponding Pulse Duration* (*D*)	*Corresponding Velocity Change*
m/s^2	ms	m/s
100	16	1·02
250	6	0·96
400	6	1·53

3.2 Measuring System

3.2.1 *Monitoring* — The impact shall be measured by an accelerometer capable of reproducing a frequency response given in Fig. 4. Its dynamic range shall be at least from 1 to 100 g. Spurious responses within the accelerometer shall not exceed a level of 2 g. The monitoring point shall be the item fixing point nearest to the centre of the table surface unless there is an item fixing point having a more rigid connection to the table in which case this shall be chosen. A typical arrangement of the acceleration instrumentation is given in Fig. 3.

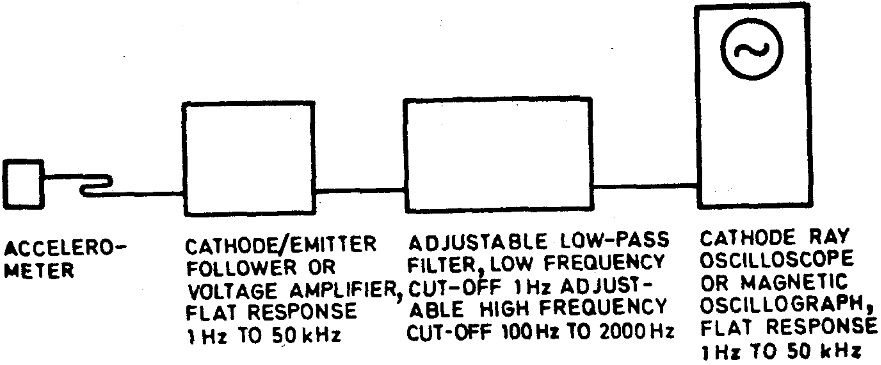
ACCELERO-METER
CATHODE/EMITTER FOLLOWER OR VOLTAGE AMPLIFIER, FLAT RESPONSE 1 Hz TO 50 kHz
ADJUSTABLE LOW-PASS FILTER, LOW FREQUENCY CUT-OFF 1 Hz ADJUSTABLE HIGH FREQUENCY CUT-OFF 100 Hz TO 2000 Hz
CATHODE RAY OSCILLOSCOPE OR MAGNETIC OSCILLOGRAPH, FLAT RESPONSE 1 Hz TO 50 kHz

FIG. 3 BLOCK DIAGRAM OF ACCELERATION INSTRUMENTATION

3.2.2 *Accuracy* — The accuracy of the measuring system shall be such that it can be determined that the true value is within the given tolerances.

3.2.3 *Frequency Characteristics* — The frequency response of the overall measuring system including the accelerometer shall be within the limits shown in Fig. 4.

NOTE — If it becomes necessary to employ filters to reduce the effect of any high frequency resonances inherent in the accelerometer, it may be necessary to examine the phase characteristics of the measuring system in order to verify that the pulse shape is maintained.

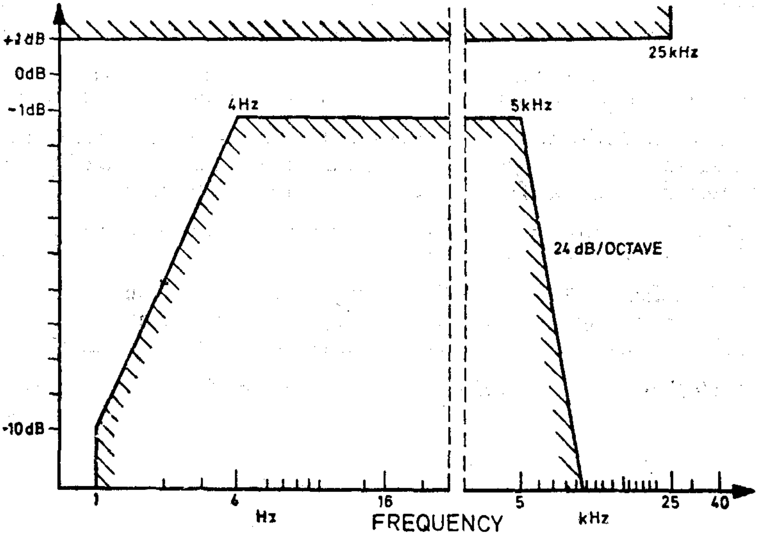

FIG. 4 FREQUENCY CHARACTERISTIC OF THE MEASURING SYSTEMS

4. CONSTRUCTION, WORKMANSHIP AND FINISH

4.1 General — The bump test machine shall be fabricated preferably with welded steel of sufficient thickness to provide necessary mechanical strength.

The table top and integral ram shall be freely mounted by two parallel motion link arms to the vertical members of base frame.

The driving unit shall be of a suitable geared variable speed dc motor operating from ac mains through a regulated rectifier unit.

4.1.1 A provision shall be made to adjust the height of the bump test machine table from 6 to 28 mm by means of screwed tappet between table ram and cam (to achieve the preferred severities detailed in **3.1.8**).

4.1.2 Detachable rubber stop base plate may have the following requirements for corresponding machine table sizes to comply with **3.1.3 :**

Table Size	*Base Plate Requirements*		
	Dimensions	*Thickness*	*Shore*
mm × mm	mm × mm	mm	*hardness*
300 × 300	150 × 150	50·0	75 to 80
600 × 600	380 × 200	50·0	75 to 80

NOTE — The shore hardness specified is suitable for peak acceleration of 400m/s^2. For other acceleration values, suitable shore hardness materials may be used.

4.1.3 *Ballast Weights* — Rectangular blocks of metal of various number are used as ballast weights to compensate the maximum load for the item to be tested. The preferred maximum loads are 25 and 125 kg.

NOTE — A coating of thin plastic layer over the flat surfaces of the ballast weights will be desirable to avoid ringing effect.

4.2 Table Size; Maximum Loading and Driving Unit — The table size corresponding to maximum loading of the machine shall be chosen from the following preferred values, unless otherwise specified:

Table Size	*Maximum Loading*	*Driving Unit Current Rating*	*Line Voltage*
mm × mm	kg	A	V
300 × 300	25	3 or suitable rating	240/415 as required by the purchaser
600 × 600	125	6 or suitable rating	

4.3 Normal Use

4.3.1 The item to be tested, including any ballast weights necessary to bring the total load to within 10 percent of the nominal load condition, shall be rigidly secured to the table in such a manner that the acceleration produced by the machine while running is fully transferred to the item.

The load shall be so positioned on the table that the distance between the vertical projection of its centre of gravity from the centre of the table does not exceed one-quarter of the table length.

4.3.2 The performance of the machine shall be checked periodically in the manner specified in **3.1** to determine possible deterioration of the machine.

4.4 Workmanship — The workmanship shall be of good current engineering practice.

4.5 Finish — The finish of machine shall be as specified for parts not otherwise covered so as to ensure protection against corrosion and other similar effects.

4.6 Miscellaneous

4.6.1 The machine shall be designed for optimum performance and economic continuous operation with minimum maintenance requirement. It shall occupy minimum floor area.

4.6.2 The electrical and electronic components and cables shall conform to relevant Indian Standards, wherever available.

4.6.3 Provision should be made for a suitable lifting jack to relieve load on the anvil.

5. INSTRUMENT CONSOLE

5.1 An instrument console consisting of required instruments shall preferably be fitted to the power supply unit for ease of operation. The instrument console shall include, *inter alia*, the following:

a) Indicating panel consisting of mains on-off switch, mains-on indicator lamp and speed controller; and

b) Five digits resettable counter shall be provided to indicate the number of bumps the item has been subjected to. The counter shall preferably have facility for switching off the machine after the required number of bumps are completed.

6. POWER SUPPLY REQUIREMENTS

6.1 The bump test machine shall be capable of operating from an ac supply of 50 Hz either from single phase 240 V ± 10 percent or three phase 415 V ± 10 percent. Total power supply input shall be declared by the manufacturer; if required by the purchaser.

The bump test machine operates from the driving unit of geared, variable speed dc motor operating from ac mains through a regulated rectifier unit.

7. SAFETY

7.1 Adequate electrical safety arrangement shall be incorporated in the machine design to avoid electric shock to the personnel and damage to the machine.

7.2 The safety protection shall be as follows:

a) Protection against supply voltage variation, and
b) Safety cut-outs for high temperature of motor winding.

8. MARKING

8.1 The machine shall be marked with the following information:

a) Manufacturer's name or trade-mark,
b) Type designation,
c) Table size,
d) Maximum loading,
e) Peak acceleration,
f) Height adjustment,
g) Bump repetition rate,
h) Power supply requirements, and
j) Any other additional marking as required.

8.1.1 The machine may also be marked with the ISI Certification Mark.

NOTE — The use of the ISI Certification Mark is governed by the provisions of the Indian Standards Institution (Certification Marks) Act and the Rules and Regulations made thereunder. The ISI Mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well-defined system of inspection, testing and quality control which is devised and supervised by ISI and operated by the producer. ISI marked products are also continuously checked by ISI for conformity to that standard as a further safeguard. Details of conditions under which a licence for the use of the ISI Certification Mark may be granted to manufacturers or processors, may be obtained from the Indian Standards Institution.

9. INSTALLATION

9.1 A suitable foundation (in consultation with an expert) is essential for the installation of the bump test machine to minimize the transfer of vibrations/shocks to adjacent areas during operation of the machine.

The bump test machine shall be securely mounted in the specified manner on to a concrete block.

10. TESTS

10.1 Each machine shall be subjected to the following tests:

a) Visual examination and inspection, and
b) Performance.

10.2 Visual Examination — Each machine shall be visually examined and inspected for compliance with the relevant requirements of this standard.

10.3 Performance — Each machine shall be subjected to performance run for a minimum of 25 000 bumps to comply with the requirements of **3**.

11. INSTRUCTION MANUAL

11.1 Each machine shall be provided with an instruction manual which shall contain the following:

a) Installation instructions;

b) Operating instruction, preferably with a calibration chart;

c) Maintenance and service instructions;

d) Schematic diagrams and design of layout;

e) List of component parts with performance data; and

f) List of spare parts.

12. INFORMATION TO BE FURNISHED BY THE INDENTOR

12.1 The following information shall be furnished by the indentor:

a) Table size (*see* **4.2**),

b) Maximum loading (*see* **4.2**),

c) Peak acceleration (*see* **3.1.8**),

d) Height adjustment (*see* **4.1.1**),

e) Bump repetition rate (*see* **3.1.5**),

f) Finish of the machine (*see* **4.5**),

g) Total power supply input (*see* **6**), and

h) Any other characteristics or parameters.

INTERNATIONAL SYSTEM OF UNITS (SI UNITS)

Base Units

Quantity	Unit	Symbol
Length	metre	m
Mass	kilogram	kg
Time	second	s
Electric current	ampere	A
Thermodynamic temperature	kelvin	K
Luminous intensity	candela	cd
Amount of substance	mole	mol

Supplementary Units

Quantity	Unit	Symbol
Plane angle	radian	rad
Solid angle	steradian	sr

Derived Units

Quantity	Unit	Symbol	Definition
Force	newton	N	1 N = 1 kg.m/s^2
Energy	joule	J	1 J = 1 N.m
Power	watt	W	1 W = 1 J/s
Flux	weber	Wb	1 Wb = 1 V.s
Flux density	tesla	T	1 T = 1 Wb/m^2
Frequency	hertz	Hz	1 Hz = 1 c/s (s^{-1})
Electric conductance	siemens	S	1 S = 1 A/V
Electromotive force	volt	V	1 V = 1 W/A
Pressure, stress	pascal	Pa	1 Pa = 1 N/m^2